RuggedSwitch™ M2200

MIL-STD 9-Port Managed Gigabit Ethernet Switch

The RuggedSwitch M2200 is a MIL-STD hardened, fully managed, modular Gigabit Ethernet switch specifically designed to operate reliably in harsh environments. The M2200's superior ruggedized hardware design coupled with the embedded Rugged Operating System (ROS™), provides improved system reliability, and advanced cyber security and networking features making it ideal for creating secure mission critical real-time control applications, and for aggregating Ethernet switches onto a Gigabit backbone.

The M2200's modular flexibility offers 1000BaseX fiber (LC connectors) and 10/100/1000BaseTX copper port (Micro-D connectors) combinations. The M2200 is packaged in a rugged galvanized steel enclosure and provides MIL-901D shock and vibration immunity. The M2200 is highly versatile and suitable for many applications within a "harsh" environment.

Features and Benefits

Ethernet Ports

- up to 9-Gigabit Ethernet ports - copper and/or fiber
- 2 port modules for tremendous flexibility
- Supports multimode and singlemode fiber
- Non-blocking, store and forward switching
- Supports LC connectors for fiber, Micro-D connectors for copper

Cyber Security Features

- Multi-level user passwords
- SSH/SSL encryption
- Enable/disable ports, MAC based port security
- Port based network access control (802.1x)
- VLAN (802.1q) to segregate and secure network traffic
- Radius centralized password management
- SNMPv3 encrypted authentication and access security

RuggedRated™ for Reliability in Harsh Environments

- Immunity to EMI and heavy electrical surges
- Zero-Packet-Loss™ Technology
- -40 to +85°C operating temperature (no fans)
- Conformal coated printed circuit boards
- 18 AWG galvanized steel enclosure

MIL-STD Ratings

- MIL-STD 901D – Shock (Hard Mounted)
- MIL-STD 167 – Vibration
- MIL-STD 461 – EMI
- MIL-STD 1399 – Magnetic Field (DC Magnetic Exposure)
- MIL-STD 810 – Temperature and Humidity

Rugged Operating System (ROS™) Features

- Simple plug and play operation - automatic learning, negotiation, and crossover detection
- RSTP (802.1w) and Enhanced Rapid Spanning Tree (eRSTP™) network fault recovery (<5ms)
- Quality of Service (802.1p) for real-time traffic
- VLAN (802.1q) with double tagging and GVRP support
- Link aggregation (802.3ad)
- IGMP Snooping for multicast filtering
- Port Rate Limiting and Broadcast Storm Limiting
- Port configuration, status, statistics, mirroring, security
- Loss of link management on fiber ports
- SNTP time synchronization (client and server)
- Industrial automation features (eg. Modbus)

Management Tools

- Web-based, Telnet, CLI management interfaces
- SNMP v1/v2/v3
- Remote Monitoring (RMON)
- Rich set of diagnostics with logging and alarms

Universal Power Supply Options

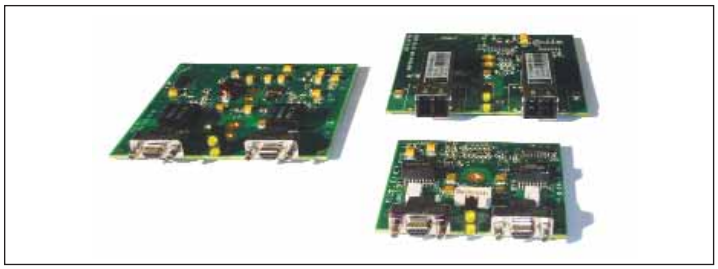
- Fully integrated, dual-redundant (optional) power supplies
- Universal high voltage range: 88-300VDC or 85-264VAC
- Popular low voltage ranges: 24VDC(9-36VDC), 48VDC (36-59VDC)
- Screw terminal blocks available
- Terminal blocks for reliable maintenance free connections
- CSA/UL 60950 safety approved to +85°C

RUGGEDCOM ISO 9001:2000 CERTIFIED

RuggedSwitch™ M2200

Modularity:

- 5 available slots
- Dual and single port modules
- Up to 9 Gigabit ports



Ethernet Modules

Operating Temperature

- -40°C to +85°C
- No Fans

Modular HMI:

- Front or Rear Mount

Mounting Options

- Panel Rail

Critical Alarm Relay

- Form-C contact ratings:
  Max Voltage 250VAC,125VDC
  Max Current 2A@250VAC,
  2A@30VDC

Gigabit Port Types:

- 10/100/1000 TX Micro-D
- 1000SX Multimode LC
- 1000LX Singlemode LC

Integrated Power Supply

- Universal high-voltage range:
  88-300VDC or 85-264VAC
- Popular low voltage DC ranges: 24VDC
  (9-36VDC), 48VDC (36-59VDC)
- True Dual Redundant Parallel
  Load Sharing (Optional)
- Screw terminal available

ROS™ Features

ROS Rugged Operating System™

Cyber Security
Cyber security is an urgent issue in many industries where advanced automation and communications networks play a crucial role in mission critical applications and where high reliability is of paramount importance. Key ROS™ features that address security issues at the local area network level include:

- **Passwords** - Multi-level user passwords secures switch against unauthorized configuration
- **SSH / SSL** - Extends capability of password protection to add encryption of passwords and data as they cross the network
- **Enable / Disable Ports** - Capability to disable ports so that traffic can not pass
- **802.1q VLAN** - Provides the ability to logically segregate traffic between predefined ports on switches
- **MAC Based Port Security** - The ability to secure ports on a switch so only specific Devices / MAC addresses can communicate via that port
- **802.1x Port Based Network Access Control** - The ability to lock down ports on a switch so that only authorized clients can communicate via this port
- **Radius** - Provides centralized password management
- **SNMPv3** - encrypted authentication and access security

The ROS™ cyber security features are included to help address the various industry specific security standards such as NERC CIP, ISA S99, AGA 12, IEC 62443, ISO 17799:2005 and PCSRF SPP-ICS.

Enhanced Rapid Spanning Tree Protocol (eRSTP™)
RuggedCom eRSTP allows the creation of fault-tolerant ring and mesh Ethernet networks that incorporate redundant links that are 'pruned' to prevent loops. eRSTP yields worst-case fault recovery[1] of 5ms times the 'bridge diameter' and allows rings of up to 80 switches. For example, a ring of ten switches will have fault recovery times under 50ms. eRSTP implements both STP and RSTP to ensure interoperability with commercial switches unlike other proprietary 'ring' solutions.

Quality of Service (IEEE 802.1p)
Some networking applications such as real-time control or VoIP (voice over IP) require predictable arrival times for Ethernet frames. Switches can introduce latency in times of heavy network traffic due to the internal queues that buffer frames and then transmit on a first come first serve basis. ROS™ supports 'Class of Service' in accordance with IEEE 802.1p that allows time critical traffic to jump ahead to the front of the queue thus minimizing latency and reducing jitter to allow such demanding applications to operate correctly. ROS™ allows priority classification by port, tags, MAC address, and IP type of service (TOS).

A configurable "weighted fair queuing" algorithm controls how frames are emptied from the queues.

VLAN (IEEE 802.1q)
Virtual local area networks (VLAN) allow the segregation of a physical network into separate logical networks with independent broadcast domains. A measure of security is provided since hosts can only access other hosts on the same VLAN and traffic storms are isolated. ROS™ supports 802.1q tagged Ethernet frames and VLAN trunks. Port based classification allows legacy devices to be assigned to the correct VLAN. GVRP support is also provided to simplify the configuration of the switches on the VLAN.

Link Aggregation (802.3ad)
The link aggregation feature provides the ability to aggregate several Ethernet ports into one logical link (port trunk) with higher bandwidth. This provides an inexpensive way to set up a high speed backbone to improve network bandwidth. This feature is also known as "port trunking", "port bundling", "port teaming", and "ethernet trunk".

IGMP Snooping
ROS uses IGMP snooping (Internet Group Management Protocol v1&v2) to intelligently forward or filter multicast traffic streams (e.g. MPEG video) to or from hosts on the network. This reduces the load on network trunks and prevents packets from being received on hosts that are not involved. ROS™ has a very powerful implementation of IGMP snooping that:

- Can be enabled on a per VLAN basis.
- Detects and filters all multicast streams regardless of whether subscribers exist.
- Supports "router-less" operation by supporting an "active" mode.
- Restores traffic streams immediately after an RSTP topology change.

SNMP (Simple Network Management Protocol)
SNMP provides a standardized method for network management stations the ability to interrogate devices from different vendors. SNMP versions supported by ROS™ are v1, v2c, and v3. SNMPv3 in particular provides security features (such as authentication, privacy, and access control) not present in earlier SNMP versions. ROS™ also supports numerous standard MIBs (Management Information Base) allowing for easy integration with any network management system (NMS).

[1] eRSTP fault recovery times may be approximated as follows:
For 100 Mbps, fault recovery performance is <5ms/hop
For 1,000 Mbps, fault recovery performance is <5ms/hop + 20ms

ROS™ Features

ROS Rugged Operating System™

SNMP (Simple Network Management Protocol) (cont'd)
A feature of SNMP supported by ROS™ is the ability to generate "traps" upon system events. A NMS can record traps from multiple devices providing a powerful network troubleshooting tool. RuggedVue™ is RuggedCom's NMS that provides graphical visualization of the network and is fully integrated with all RuggedCom products.

SNTP (Simple Network Time Protocol)
SNTP automatically synchronizes the internal clock of all ROS™ devices on the network. This allows for correlation of time stamped events for troubleshooting.

SCADA and Industrial Automation
ROS™ contains features that optimize network performance and simplify switch management based on the unique requirements found in SCADA and industrial automation applications. Features such as Modbus TCP management for retrieval of switch data using the ubiquitous Modbus protocol and DHCP Option 82, a Rockwell Automation ODVA requirement for IP address assignment based on the location of the end device, provide capabilities not found in typical "commercial" or "office grade" Ethernet switches.

Port Based Network Access Control (802.1x)
ROS™ supports the IEEE 802.1x standard that defines a mechanism for port-based network access control which provides a means of authenticating and authorizing devices attached to LAN ports.

Port Rate Limiting
ROS™ supports configurable rate limiting per port to limit unicast and multicast traffic. This can be essential to managing precious network bandwidth for service providers. It also provides edge security for denial of service (DOS) attacks.

Broadcast Storm Filtering
Broadcast storms wreak havoc on a network and can cause attached devices to malfunction. This could be disastrous on a network with mission critical equipment. ROS™ limits this by filtering broadcast frames with a user-defined threshold.

Loss of Link Management
Some intelligent electronic devices (IEDs) have dual fiber optic ports with automatic failover to a backup port should the primary fail. ROS™ ensures this mechanism works reliably under all failure modes by appropriately disabling link signals when required. ROS™ also flushes learned MAC addresses to ensure the failover occurs quickly.

Port Mirroring
ROS™ can be configured to duplicate all traffic on one port to a designated mirror port. When combined with a network analyzer, this can be a powerful troubleshooting tool.

Port Configuration and Status
ROS™ allows individual ports to be 'hard' configured for speed, duplex, auto-negotiation, flow control and more. This allows proper connection with devices that do not negotiate or have unusual settings. Detailed status of ports with alarm and SNMP trap on link problems aid greatly in system troubleshooting.

Port Statistics and RMON (Remote Monitoring)
ROS™ provides continuously updating statistics per port that provide both ingress and egress packet and byte counters as well as detailed error figures. Also provided is full support for the RMON statistics, history, alarms, and event groups. RMON allows for very sophisticated data collection, analysis and detection of traffic patterns.

Event Logging and Alarms
ROS™ records all significant events to a non-volatile system log allowing forensic troubleshooting. Events include link failure and recovery, unauthorized access, broadcast storm detection, and self-test diagnostics among others. Alarms provide a snapshot of recent events that have yet to be acknowledged by the network administrator. An external hardware relay is de-energized during the presence of critical alarms allowing an external controller to react if desired.

HTML Web Browser and Telnet User Interfaces
ROS™ provides a simple, intuitive user interface for configuration and monitoring via a standard graphical web browser or via Telnet. All system parameters include detailed on-line help to make setup a breeze. ROS™ , presents a common look and feel and standardized configuration process allowing easy migration to other RuggedCom managed products.

Configuration via ASCII Text File
All configuration parameters are stored in an ASCII formatted text file that can easily be transferred via TFTP or Xmodem. The configuration file can be saved for backup purposes and easily manipulated by a text editor. The same text file can be downloaded to the switch at a later date in order to re-configure or restore a previous configuration.

Command Line Interface (CLI)
A command line interface can be used in conjunction with remote shell to automate data retrieval, configuration updates, and firmware upgrades. A powerful SQL-like capability allows expert users the ability to selectively retrieve or manipulate any parameters the device has to offer.

ROS Rugged Operating System™

EMI and Environmental Type Tests

IEC 61850-3 EMI TYPE TESTS				
TEST	**Description**		**Test Levels**	**Severity Levels**
IEC 61000-4-2	ESD	Enclosure Contact	+/- 8kV	4
		Enclosure Air	+/- 15kV	4
IEC 61000-4-3	Radiated RFI	Enclosure ports	20 V/m	x
IEC 61000-4-4	Burst (Fast Transient)	Signal ports	+/- 4kV @ 2.5kHz	x
		D.C. Power ports	+/- 4kV	4
		A.C. Power ports	+/- 4kV	4
		Earth ground ports [3]	+/- 4kV	4
IEC 61000-4-5	Surge	Signal ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
		D.C. Power ports	+/- 2kV line-to-earth, +/- 1kV line-to-line	3
		A.C. Power ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
IEC 61000-4-6	Induced (Conducted) RFI	Signal ports	10V	3
		D.C Power ports	10V	3
		A.C. Power ports	10V	3
		Earth ground ports [3]	10V	3
IEC 61000-4-8	Magnetic Field	Enclosure ports	40 A/m continuous, 1000 A/m for 1 s	N/A
IEC 61000-4-29	Voltage Dips & Interrupts	D.C. Power ports	30% for 0.1s, 60% for 0.1s, 100% for 0.05s	N/A
		A.C. Power ports	30% for 1 period, 60% for 50 periods	N/A
IEC 61000-4-11			100% for 5 periods, 100% for 50 periods [2]	N/A
IEC 61000-4-12	Damped Oscillatory	Signal ports	2.5kV common, 1kV diff. mode@1MHz	3
		D.C. Power ports	2.5kV common, 1kV diff. mode@1MHz	3
		A.C. Power ports	2.5kV common, 1kV diff. mode@1MHz	3
IEC 61000-4-16	Mains Frequency Voltage	Signal ports	30V Continuous, 300V for 1s	4
		D.C. Power ports	30V Continuous, 300V for 1s	4
IEC 61000-4-17	Ripple on D.C. Power Supply	D.C. Power ports	10%	3
IEC 60255-5	Dielectric Strength	Signal ports	2kVac (Fail-Safe Relay output)	N/A
		D.C. Power ports	2kVac	N/A
		A.C. Power ports	2kVac	N/A
IEC 60255-5	H.V. Impulse	Signal ports	5kV (Fail-Safe Relay output)	N/A
		D.C. Power ports	5kV	N/A
		A.C. Power ports	5kV	N/A

IEEE 1613 (C37.90.x) EMI IMMUNITY TYPE TESTS				
Test	**Description**		**Test Levels**	**Severity Levels**
IEEE C37.90.3	ESD	Enclosure Contact	+/- 8kV	N/A
		Enclosure Air	+/- 15kV	N/A
IEEE C37.90.2	Radiated RFI	Enclosure ports	35 V/m	N/A
IEEE C37.90.1	Fast Transient	Signal ports	+/- 4kV @ 2.5kHz	N/A
		D.C. Power ports	+/- 4kV	N/A
		A.C. Power ports	+/- 4kV	N/A
		Earth ground ports3	+/- 4kV	N/A
IEEE C37.90.1	Oscillatory	Signal ports	2.5kV common mode @1MHz	N/A
		D.C. Power ports	2.5kV common, 1kV diff. mode@1MHz	N/A
		A.C. Power ports	2.5kV common, 1kV diff. mode@1MHz	N/A
IEEE C37.90	H.V. Impulse	Signal ports	5kV (Fail-Safe Relay output)	N/A
		D.C. Power ports	5kV	N/A
		A.C. Power ports	5kV	N/A
IEEE C37.90	Dielectric Strength	Signal ports	2kVac	N/A
		D.C. Power ports	2kVac	N/A
		A.C. Power ports	2kVac	N/A

MILITARY STANDARD TESTS		
MIL-STD	**Description**	**Details**
MIL-STD-901D *	Shock (Hard-Mounted)	Grade A, Equipment Class I, Shock Type A Equipment
MIL-STD-167-1 *	Vibration	Type I (Upper Frequency of 33 Hz)
MIL-STD-461E *	Electromagnetic Interference	CE101, CE102, CS101, CS114, CS115, CS116, RE101, RE102, RS101, RS103
MIL-STD-1399 *	Magnetic Field - DC Magnetic Exposure	Section 070, Part 1
MIL-STD-810F *	Temperature - Low/High Temperature	Method 501
MIL-STD-810 *	Temperature - Non-operating Thermal Shock	Method 503
MIL-STD-810 *	Humidity	Method 507, Procedure IV

Notes:
1. Only applicable to functional earth connections separated from the safety earth connection.
2. Class 2 refers to "Measuring relays and protection equipment for which a very high security margin is required or where the vibration levels are very high, (e.g. shipboard application and for severe transportation conditions")

* Testing complete, pending final documentation (contact RuggedCom for complete details)

Technical Specifications

Power Supply
- Power Consumption: 28W Max
- 24VDC: 9-36 VDC, 1.2A
- 48VDC: 36-59 VDC, 0.6A
- HI Voltage AC/DC: 88-300VDC or 85-264VAC

Critical Alarm Relay
- Form-C contact ratings:
  Max Voltage 250VAC,125VDC
  Max Current 2A@250VAC, 2A@30VDC

Physical
- Height: 1.74"
- Width: 18.3"
- Depth: 12.4"
- Weight: 4.8kg
- Ingress Protection: IP40 (1mm objects)
- Enclosure: 18 AWG galvanized steel enclosure
- Mounting: Panel mounted

Switch Properties
- Switching method: Store & Forward
- Switching latency: 7 us
- Switching bandwidth:18Gbps
- MAC addresses: 8192
- MAC address table size: 64kbytes
- Priority Queues: 4
- Frame buffer memory: 2 Mbit
- VLANs: 4094
- IGMP multicast groups: 256
- Port rate limiting
- No head of line blocking

Approvals
- ISO: Designed and manufactured using a ISO9001: 2000 certified quality program
- CE Marking
- Emissions: FCC Part 15 (Class A),
  EN55022 (CISPR22 Class A)
- Safety: cCSAus (Compliant with CSA C22.2 No. 60950, UL 60950, EN60950)
- Laser Eye Safety (FDA/CDRH): Complies with 21 CFR Chapter1, Subchapter J.

Warranty
- 5 Years - Applicable to design and manufacturing related product defects.

Network Management
- HTTP graphical web-based
- SNMP v1, v2c, v3
- Telnet, VT100
- Command Line Interface (CLI)

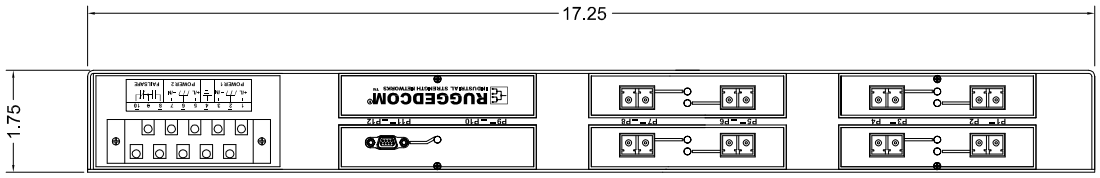
EMI Immunity and Environmental Compliance
- IEC 61000-6-2 Industrial (Generic)
- IEC 61800-3 Industrial (Variable Speed Drive Systems)
- IEC 61850-3 Electric Utility Substations
- IEEE 1613 Electric Utility Substations
- NEMA TS 2 Traffic Control Equipment

IEEE Compliance
- 802.3-10BaseT
- 802.3u-100BaseTX, 100BaseFX
- 802.3x-Flow Control
- 802.3z-1000BaseLX
- 802.3ab-1000BaseTX
- 802.3ad-Link Aggregation
- 802.1d-MAC Bridges
- 802.1d-Spanning Tree Protocol
- 802.1p-Class of Service
- 802.1q-VLAN Tagging
- 802.1w-Rapid Spanning Tree Protocol
- 802.1x-Port Based Network Access Control

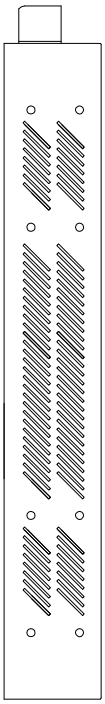
IETF RFC Compliance
- RFC768-UDP
- RFC783-TFTP
- RFC791-IP
- RFC792-ICMP
- RFC793-TCP
- RFC826-ARP
- RFC854-Telnet
- RFC894-IP over Ethernet
- RFC1112-IGMP v1
- RFC1519-CIDR
- RFC1541-DHCP (client)
- RFC2030-SNTP
- RFC2068-HTTP
- RFC2236-IGMP v2
- RFC2284-EAP
- RFC2475-Differentiated Services
- RFC2865-Radius
- RFC3414-SNMPv3-USM
- RFC3415-SNMPv3-VACM

IETF SNMP MIBS
- RFC1493-BRIDGE-MIB
- RFC1907-SNMPv2-MIB
- RFC2012-TCP-MIB
- RFC2013-UDP-MIB
- RFC2578-SNMPv2-SMI
- RFC2579-SNMPv2-TC
- RFC2819-RMON-MIB
- RFC2863-IF-MIB
- draft-ietf-bridge-rstpmib-03-BRIDGE-MIB
- draft-ietf-bridge-bridgemib-smiv2-03-RSTP-MIB
- IANAifType-MIB

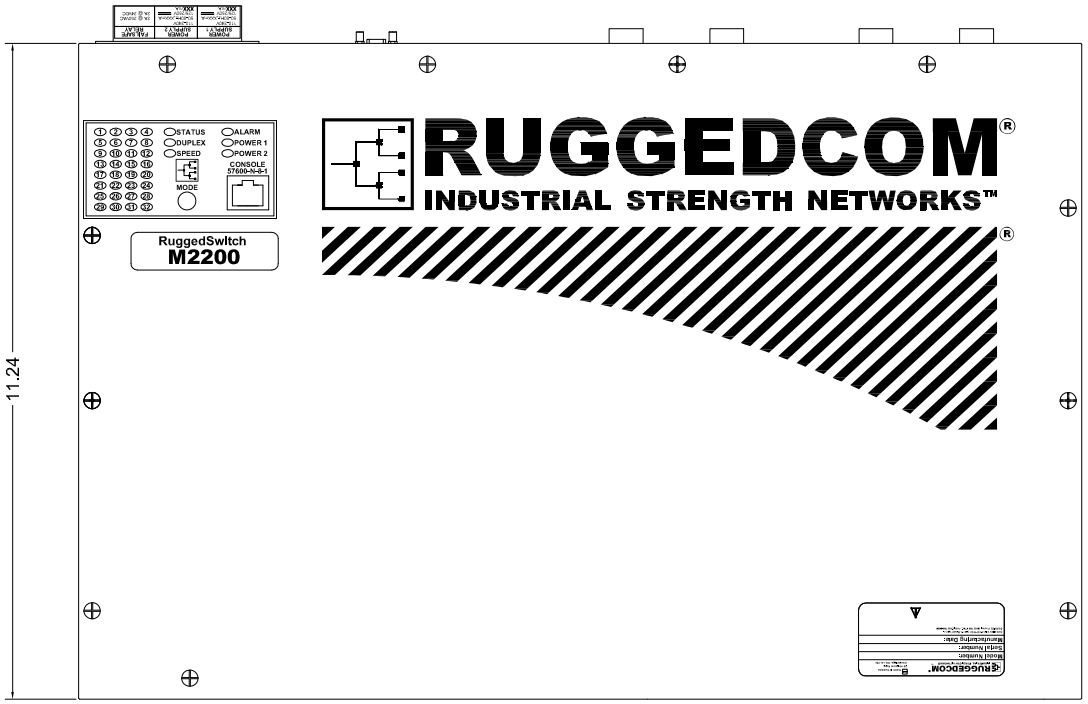
Dimensions



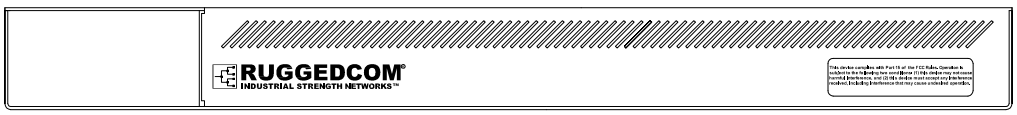
FRONT VIEW



SIDE VIEW



TOP VIEW

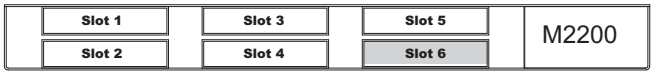


REAR VIEW

PANEL MOUNTING KIT SUPPLIED WITH UNIT. SEE INSTALL GUIDE

Order Codes

M2200 -_____ -_____ -____ -____ -____ -____ -____ -____ -____
Main Mount PS1 PS2 S1 S2 S3 S4 S5



Main: Ethernet and Power Connectors
- B = Ethernet on rear; LED panel on top; power connector on rear
- T = Ethernet on front; LED panel on top; power connector on rear

Mount: Mounting Options
- DP = Panel Mount Kit

PS1 and PS2: Power Supply 1 and 2
- 24 = 24VDC (9-36VDC), screw terminal block
- 48 = 48VDC (36-59VDC), screw terminal block
- HI = 88-300VDC or 85-264VAC, screw terminal block
- XX = No Power Supply (PS2 Only)

S1, S2, S3, S4: Gigabit Ethernet Modules for Slots 1, 2, 3, and 4
- XXXX = Empty
- CG02 = 2 x 10/100/1000Tx Micro-D
- FG01 = 2 x 1000SX - Multimode, 850nm, LC, 500m
- FG03 = 2 x 1000LX - Singlemode, 1310nm, LC connectors, 10km
- FG05 = 2 x 1000LX - Singlemode, 1310nm, LC connectors, 25km

S5: Gigabit Ethernet Modules for Slot 5
- XXXXX = Empty
- 1CG02 = 1 x 10/100/1000Tx Micro-D
- 1FG01 = 1 x 1000SX - Multimode, 850nm, LC, 500m
- 1FG03 = 1 x 1000LX - Singlemode, 1310nm, LC connectors, 10km
- 1FG05 = 1 x 1000LX - Singlemode, 1310nm, LC connectors, 25km

NOTES:
1 Distance ratings are typical but will depend on type of cabling, number of connectors and splices.

Example Order Codes:

M2200-B-DP-24-XX-FG03-FG03-XXXX-XXXX-XXXXX
Panel Mount Kit, Single 24VDC power supply, 4 1000LX Gigabit Ethernet Ports (Singlemode 1310nm fiber, LC connectors), with Ethernet ports on the rear

M2200-B-DP-48-48-CG01-CG02-FG02-FG01-XXXX-XXXXX
Panel Mount Kit, Dual 48VDC power supplies, 4 10/100/1000 Ethernet Ports, 4 1000SX Gigabit Ethernet Ports (Multimode 1300nm fiber, LC connectors) Ethernet ports, with Ethernet ports on the rear.

M2200-B-DP-HI-48-FG03-FG03-FG03-FG03-1FG03
Panel Mount Kit, Dual power supplies (HI and 48VDC), 9 1000LX Gigabit Ethernet Ports Singlemode, 1300nm, LC connectors, with Ethernet ports on the rear.

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Patent Pending
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Rev 1-J

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